United States Patent [19]

Putkowski

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[54] **PRESS WITH WEDGE**

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[30] **Foreign Application Priority Data**

Aug. 25, 1982 [CA] Canada 410056

[51] **Int. Cl.**³ **B30B 1/40**

[52] **U.S. Cl.** .... **100/214**; 72/452; 83/627; 100/229 R; 100/232; 100/291; 425/451.7

[58] **Field of Search** .... 100/214, 291, 292, 232, 100/229 R; 425/451.7, DIG. 129, DIG. 221, 411; 72/452; 83/613, 627

[56] **References Cited**

U.S. PATENT DOCUMENTS

174,058	2/1876	Berry	100/291 X
188,290	3/1877	Gilman	100/291 X
188,513	3/1877	Golding	100/291 X
353,606	11/1886	Stupakoff	100/291
370,509	9/1887	Webb	100/291 X
1,765,762	6/1930	Hanna	100/291 X
2,204,151	6/1940	Rodefer	425/DIG. 129
3,122,033	2/1964	Riemenschneider	100/291 X
3,208,105	9/1965	White	100/291 X
3,667,891	6/1972	Gelin	425/451.7 X
3,743,469	7/1973	Gibbons	100/291 X
3,844,157	10/1974	Bachmann	100/291 X
3,913,438	10/1975	Walters	100/291 X
3,939,686	2/1976	Walters	100/291 X
4,339,940	7/1982	Mackay	72/425 X

FOREIGN PATENT DOCUMENTS

2017676	10/1971	Fed. Rep. of Germany	100/214
2408939	1/1975	Fed. Rep. of Germany	100/291

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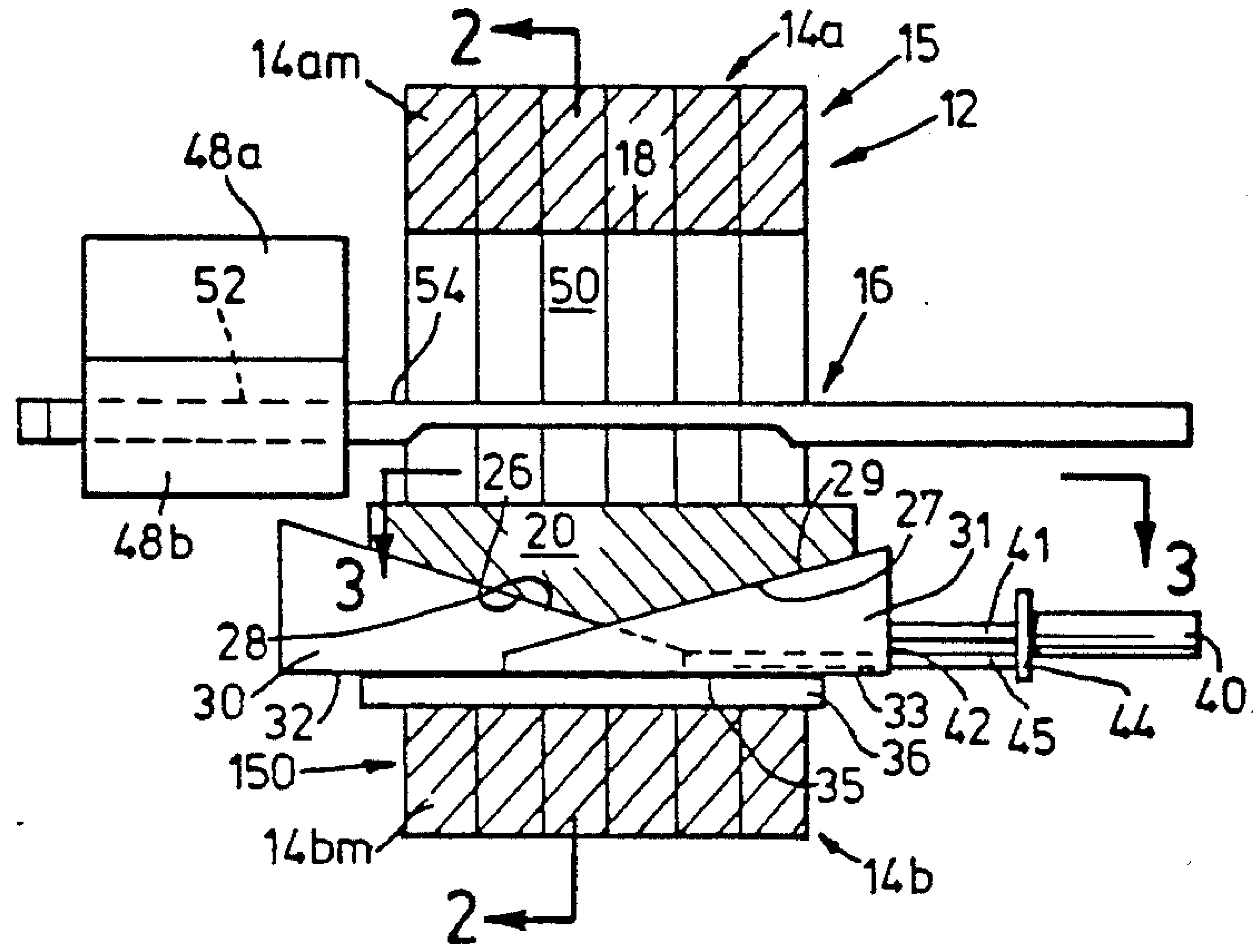
Attorney, Agent, or Firm—Rogers, Bereskin & Parr

[57] **ABSTRACT**

A press having a pre-stressed frame, to reduce the energy required in each pressing cycle, and in which oppositely acting wedges provide the clamping force. The mold or other structure to be pressed is assembled outside the press and then is slid on guide rails into the press with very small clearances. The press can also be used for molds or dies fixed to stationary or movable platens.

20 Claims, 21 Drawing Figures



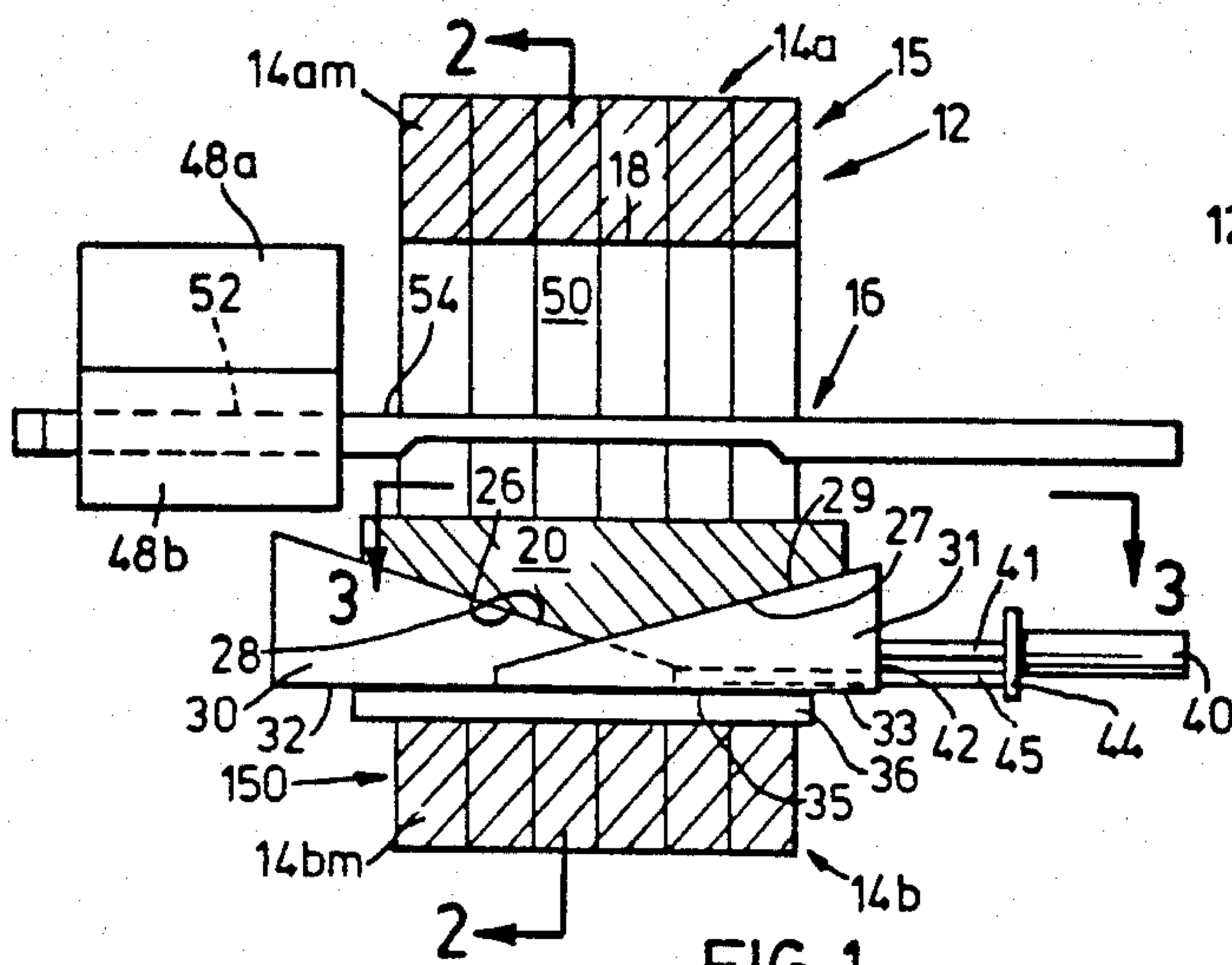


FIG. 1

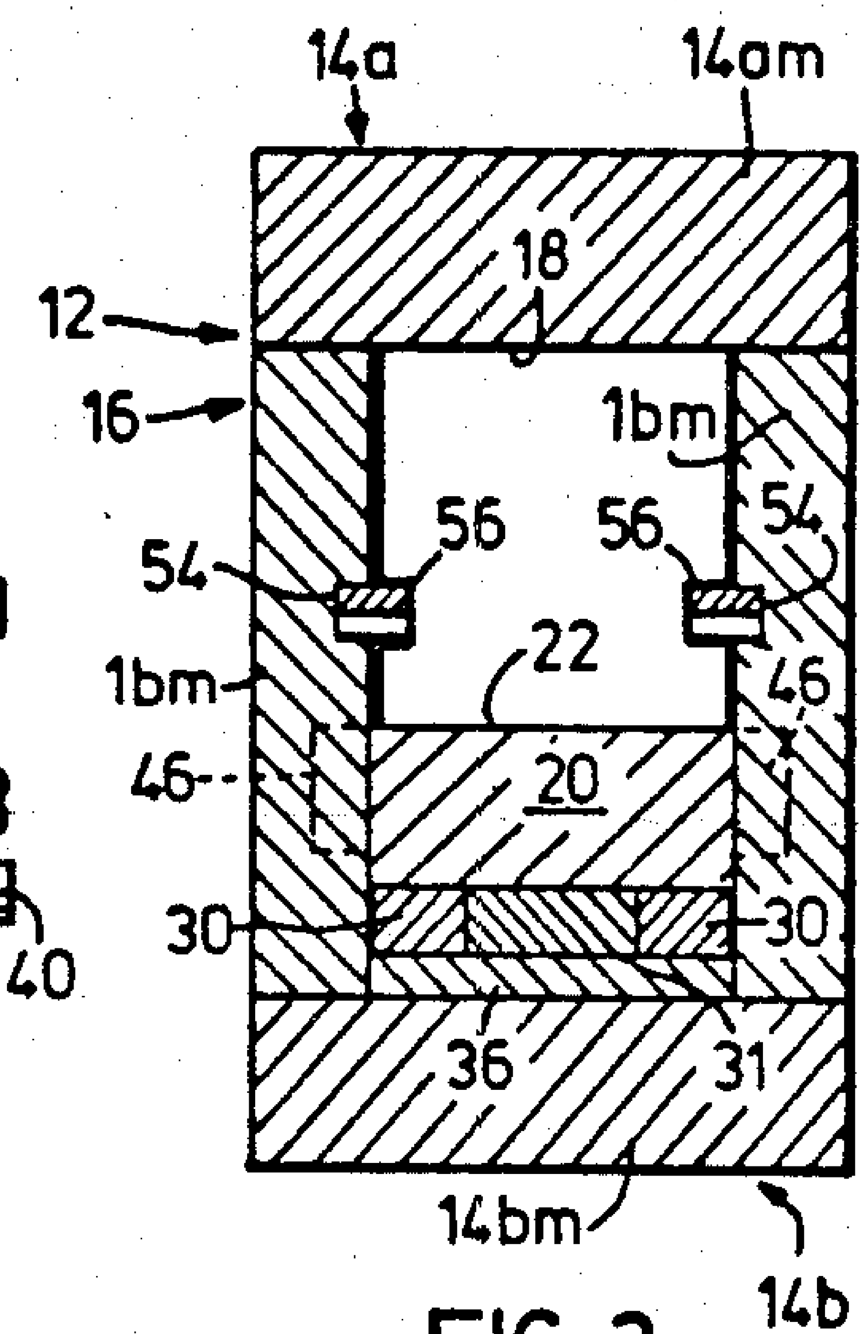


FIG. 2

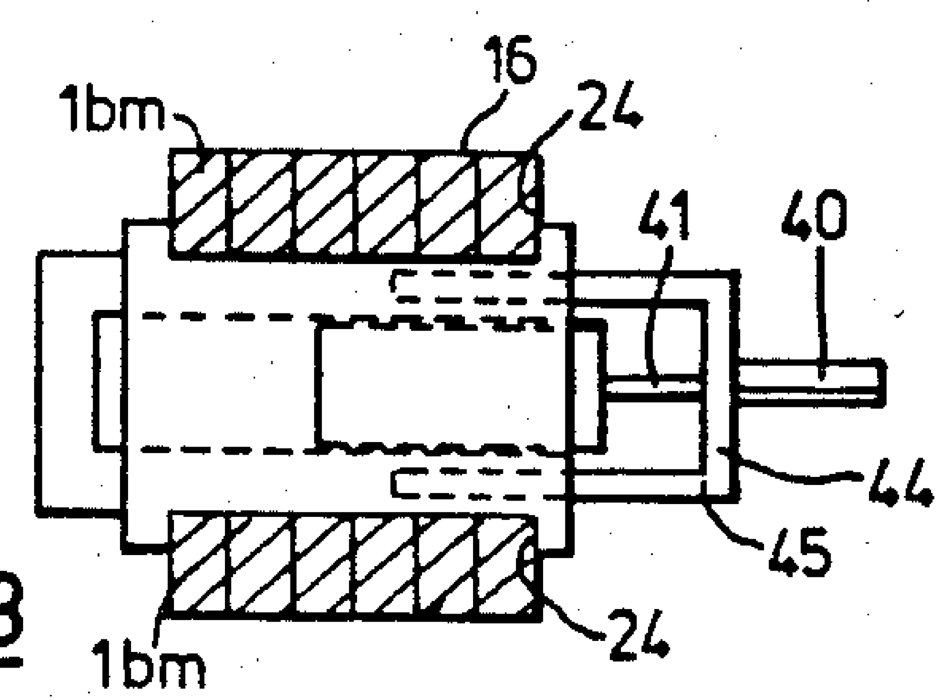


FIG. 3

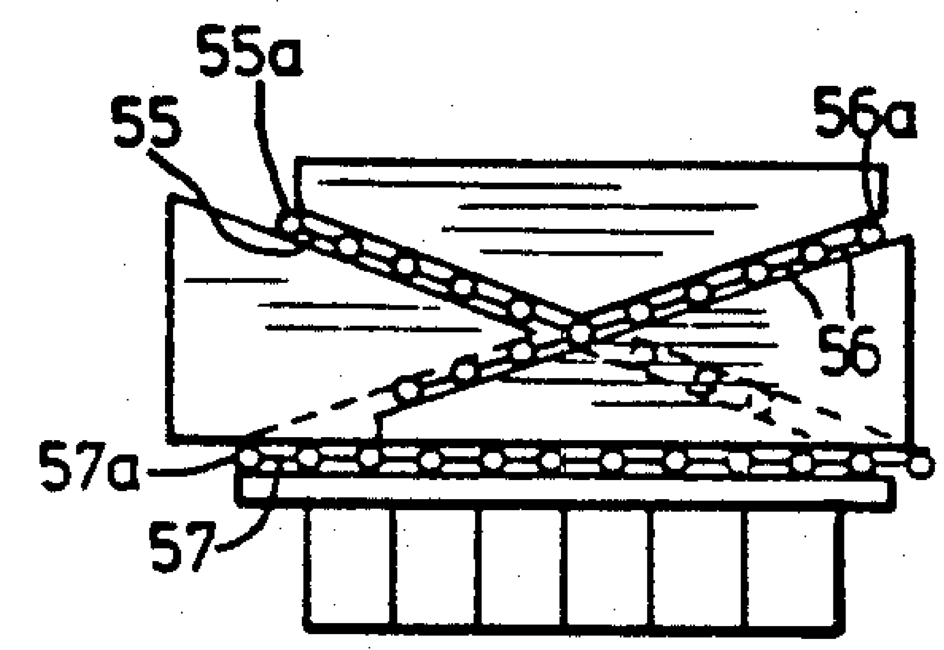


FIG. 4

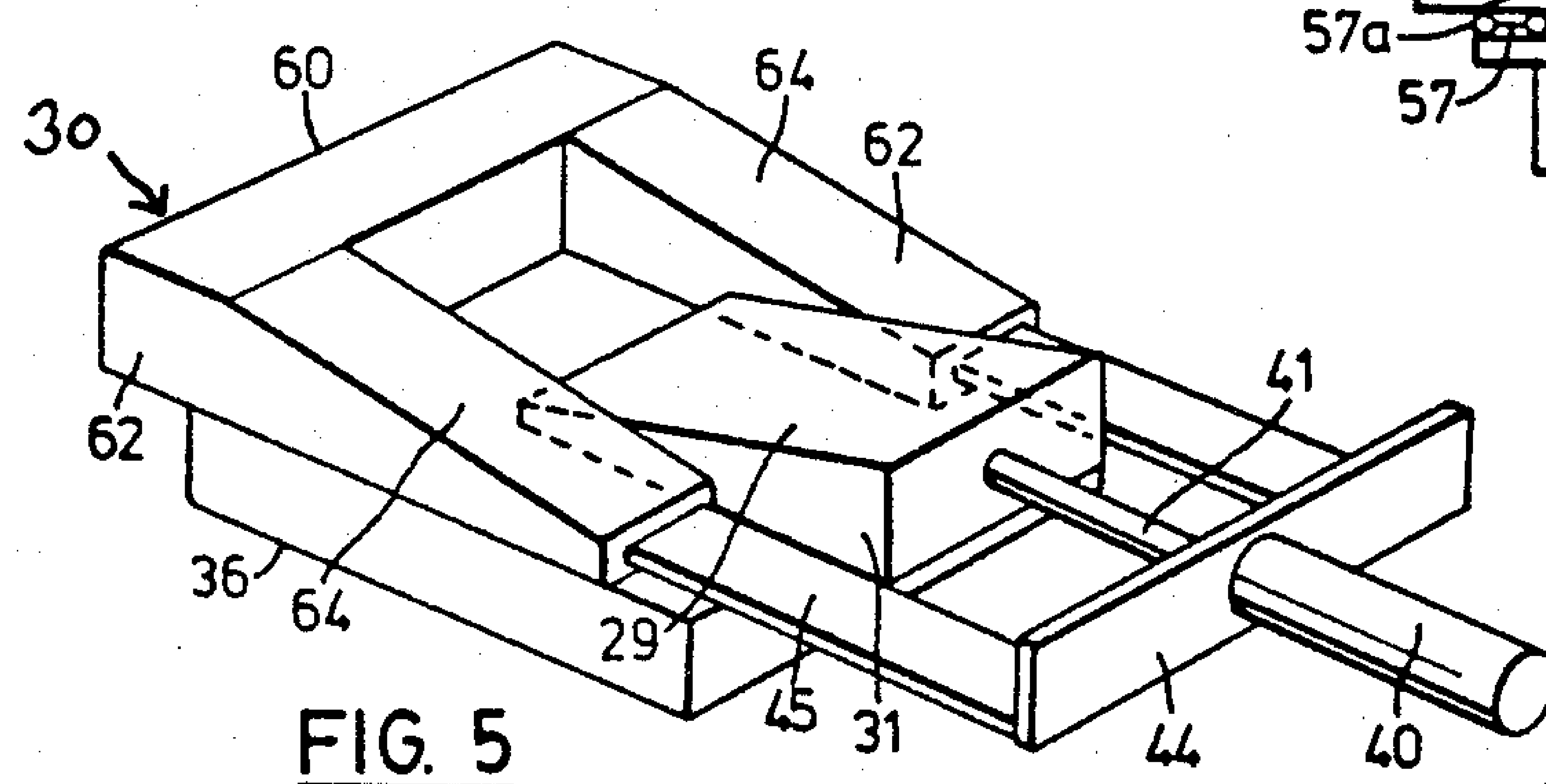


FIG. 5

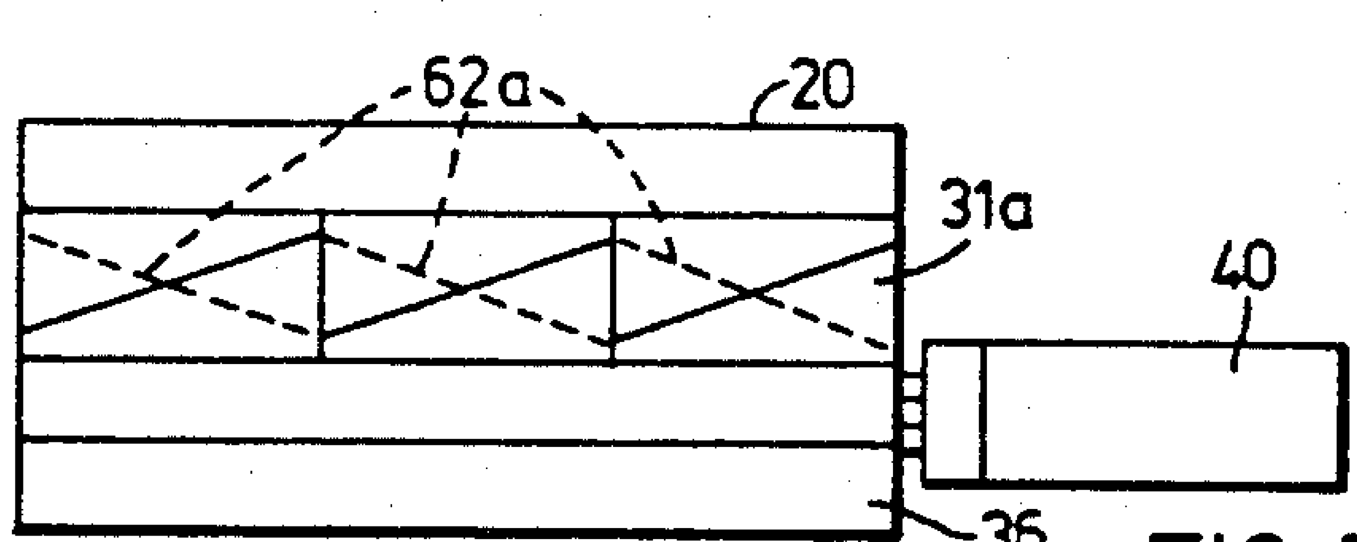


FIG. 5a

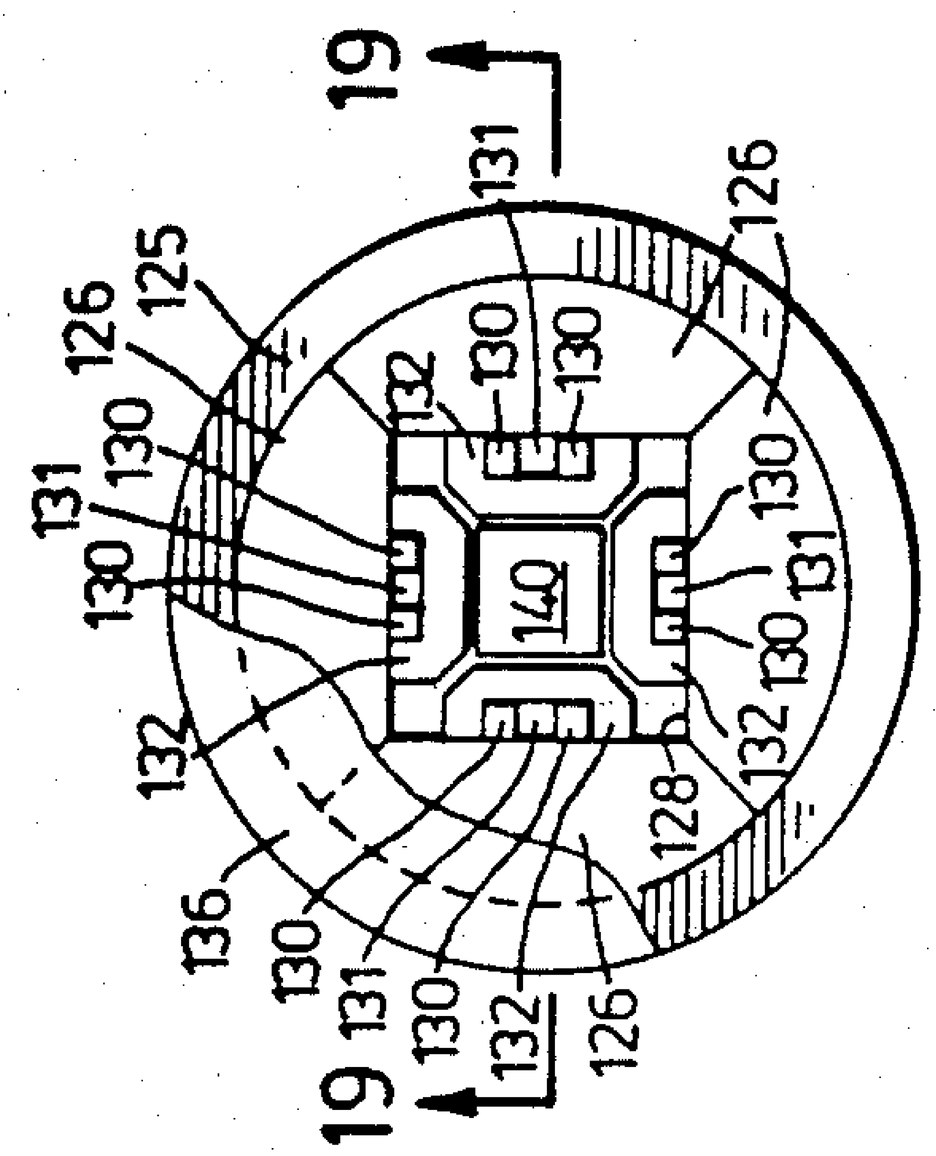


FIG. 18

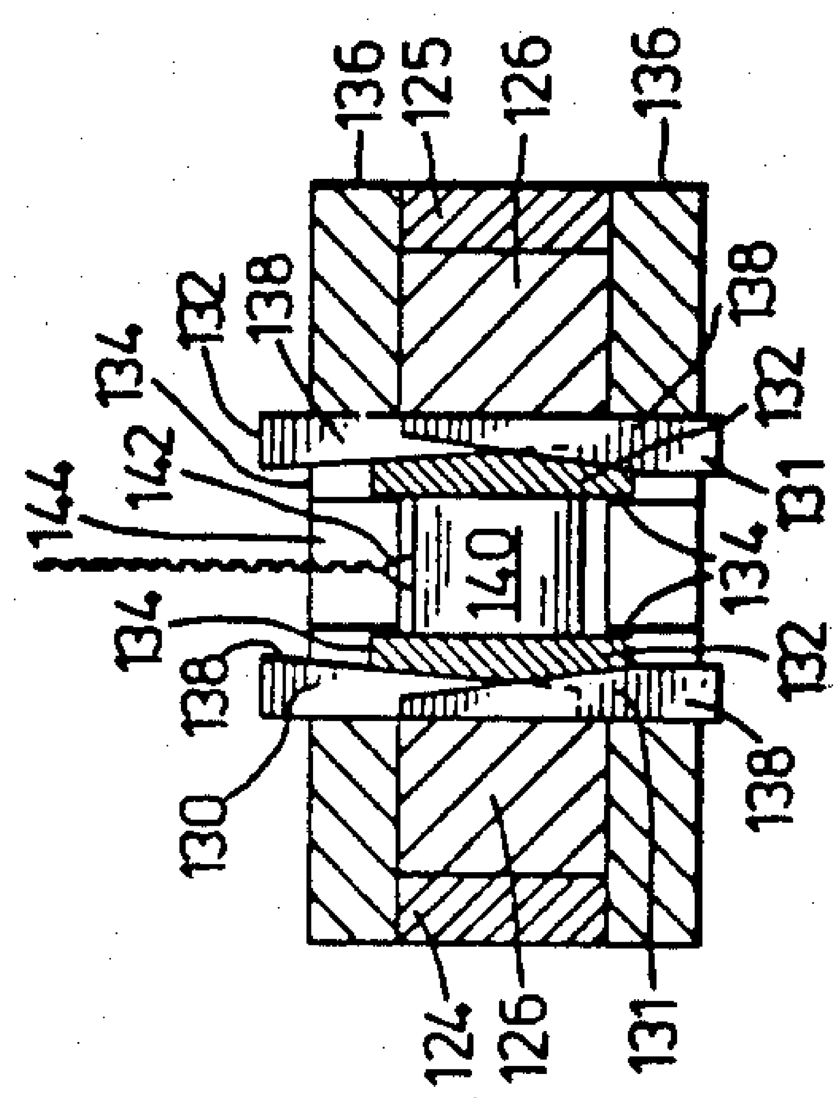


FIG. 19

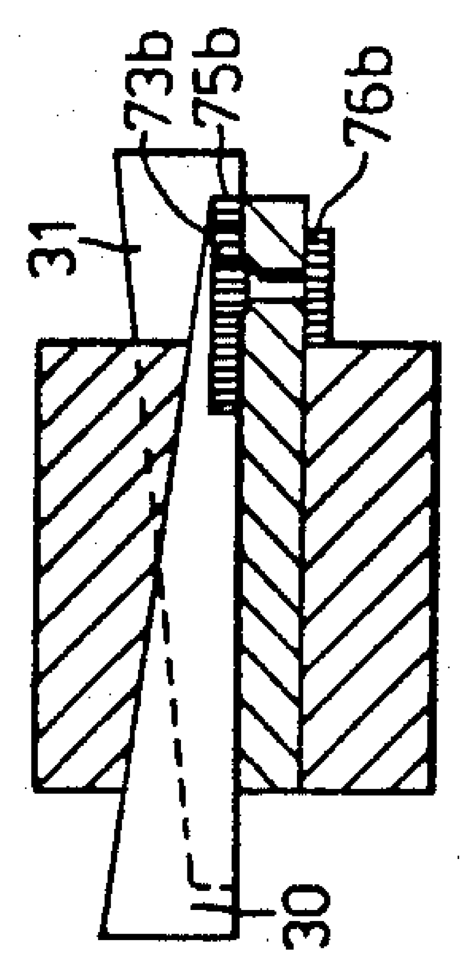


FIG. 8

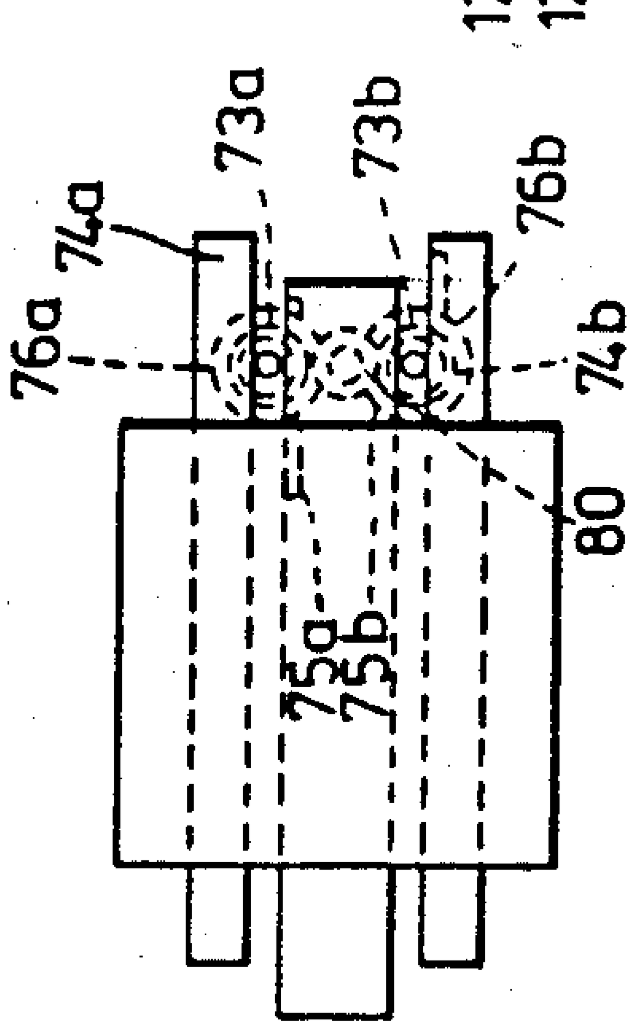


FIG. 9

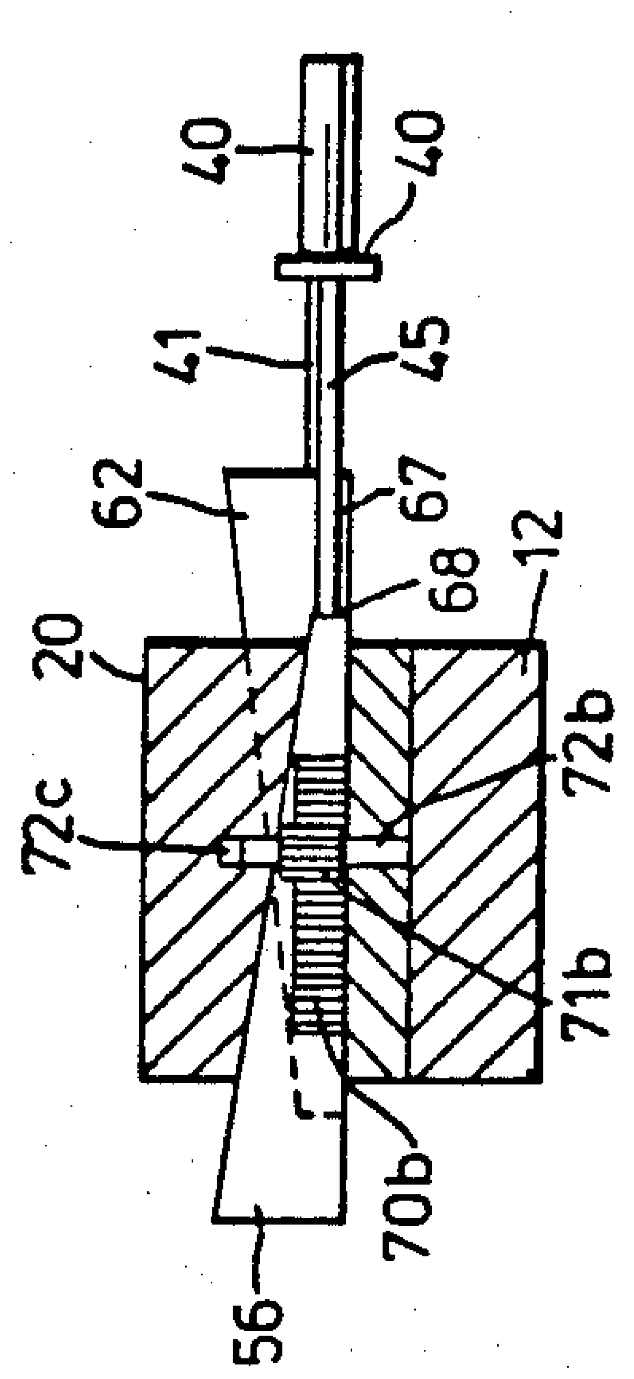


FIG. 6

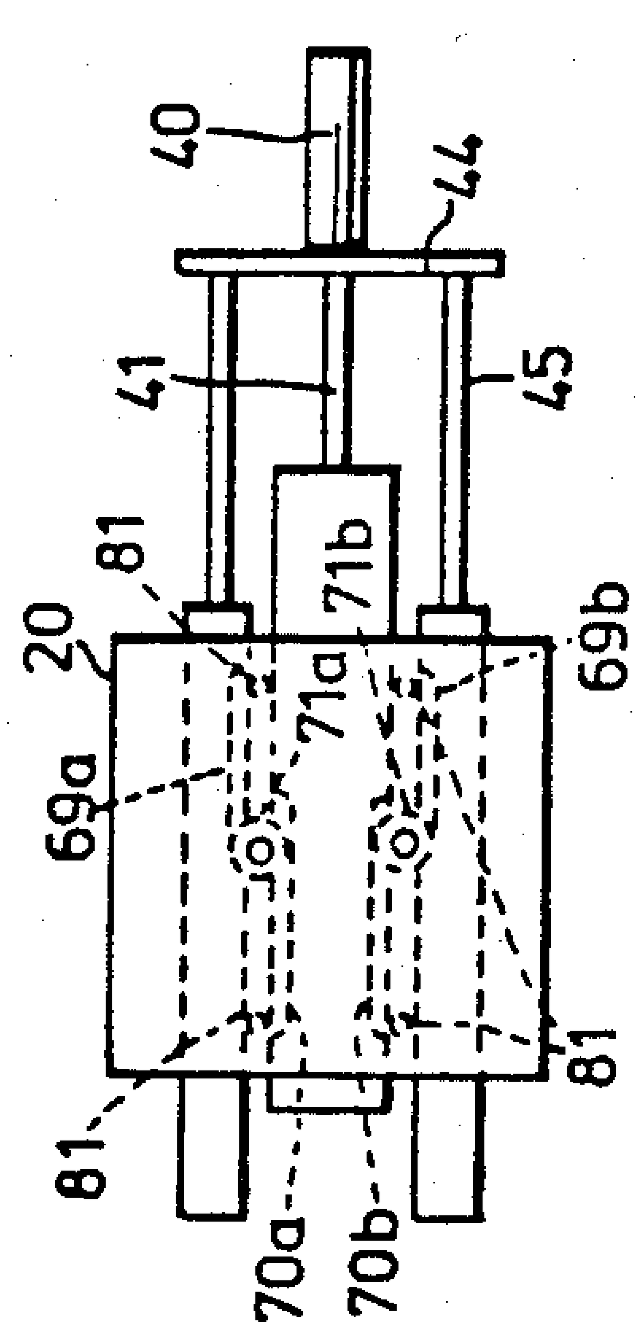


FIG. 7

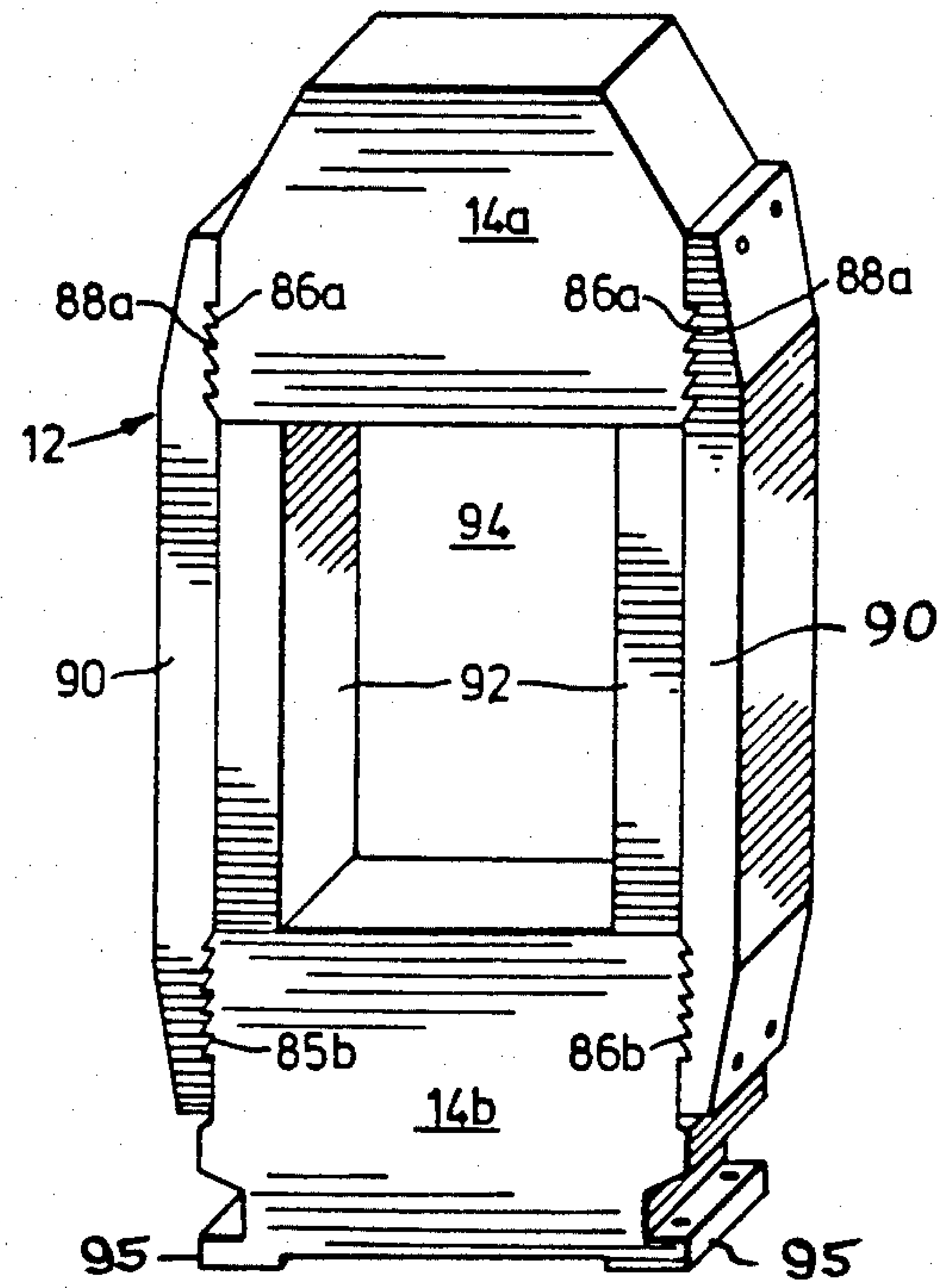


FIG 10

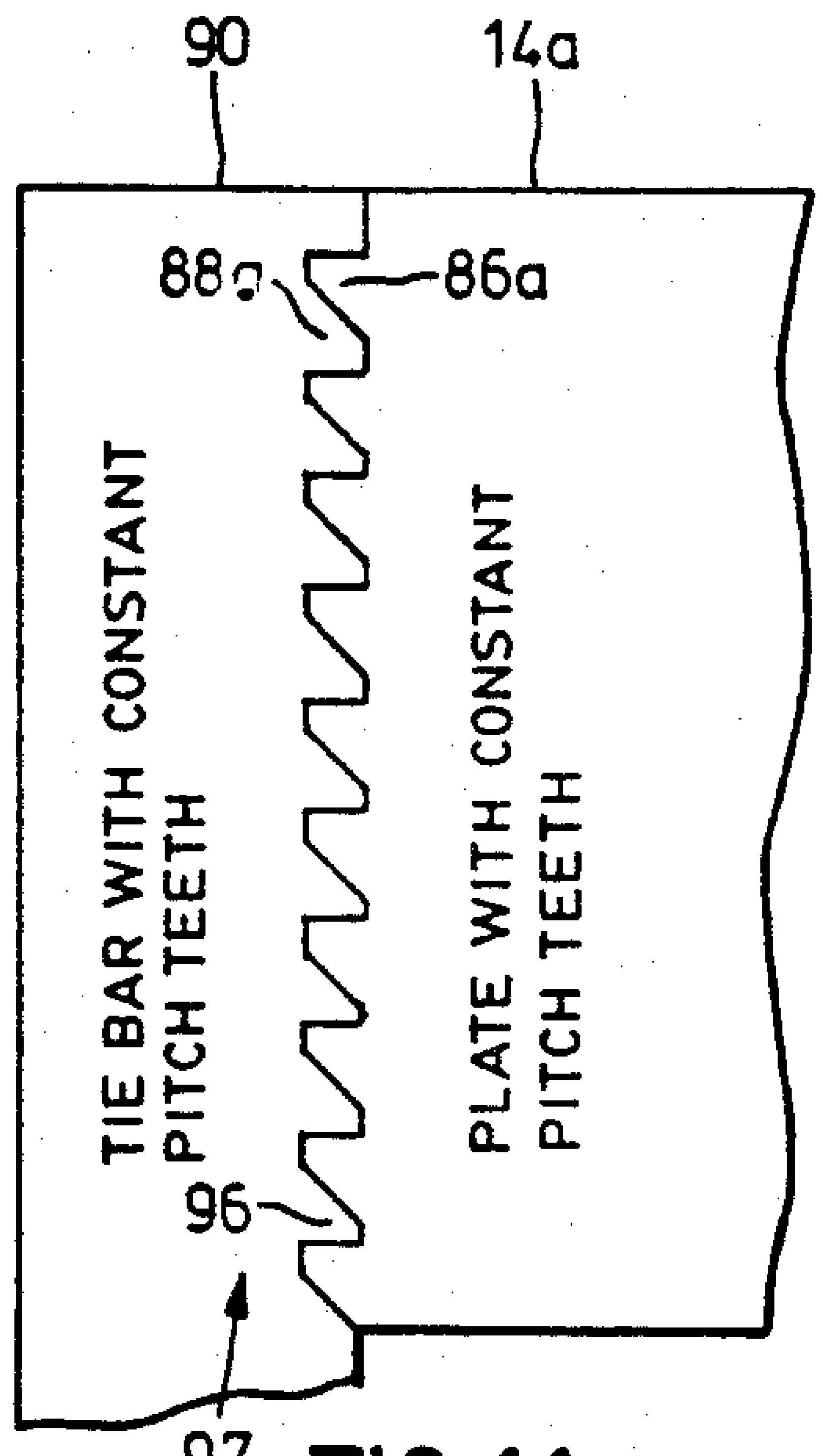


FIG 11a

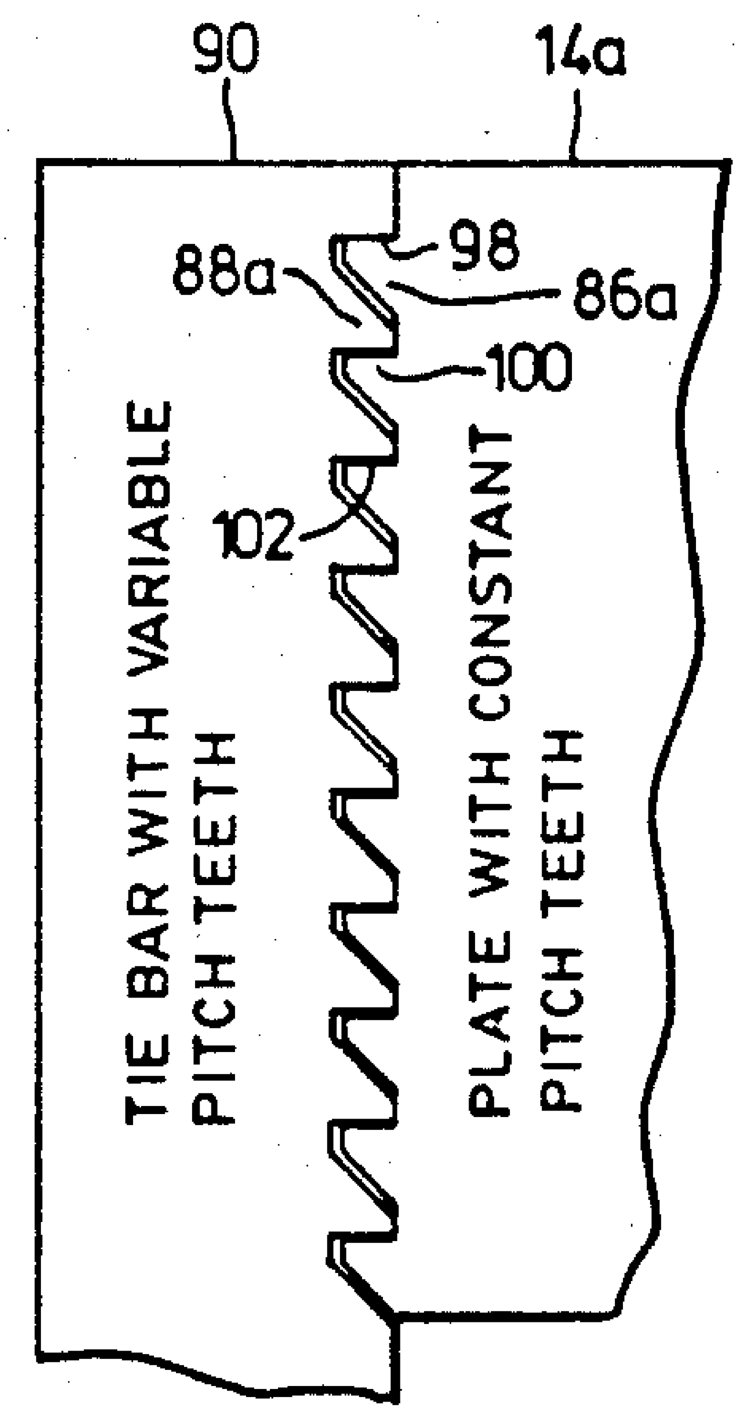


FIG 11b

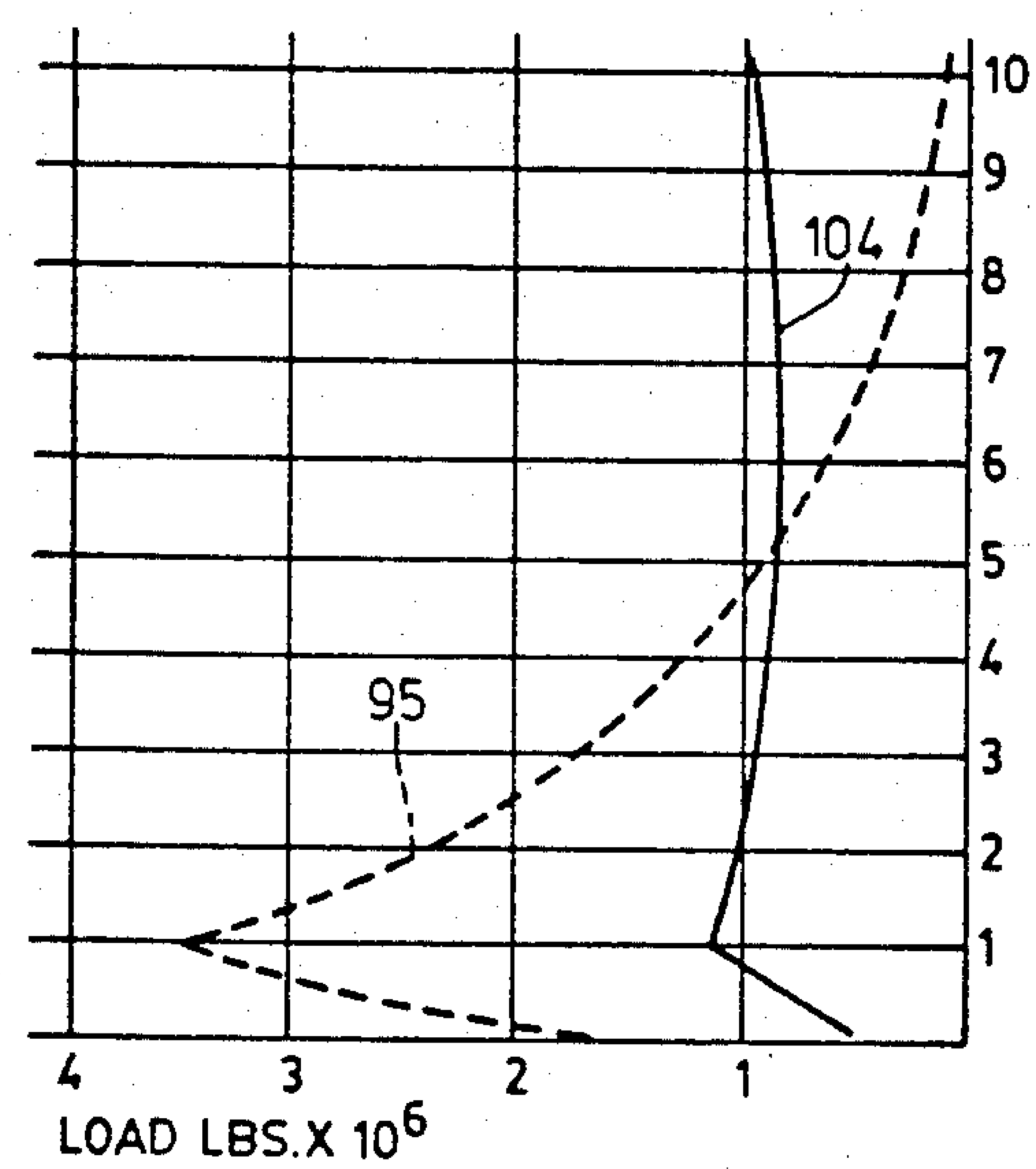

10
9
8
7
6
5
4
3
2
1
104
95
4
3
2
1
LOAD LBS.X 10^6

FIG. 12

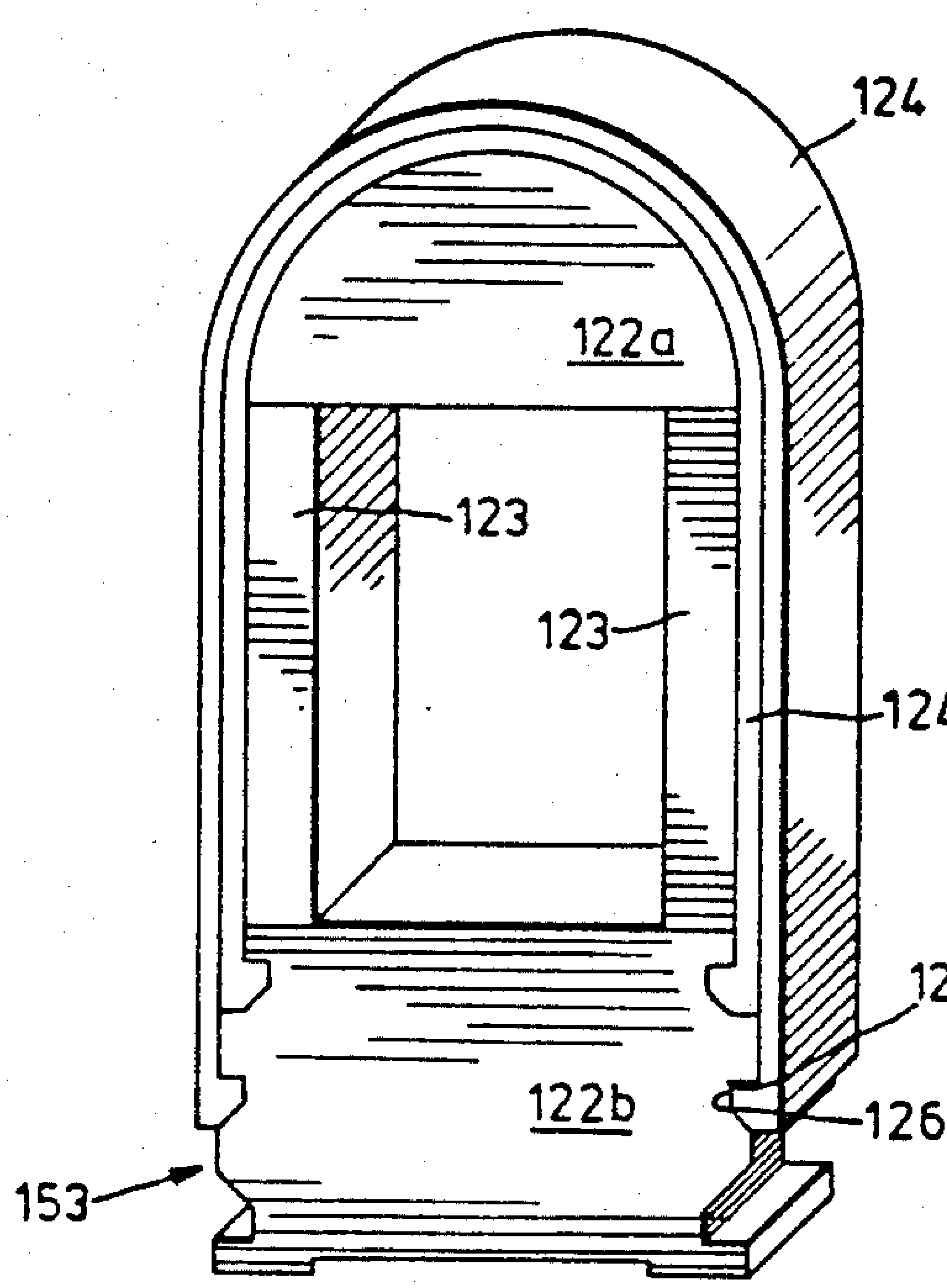

124
122a
123
123
124
125
122b
126
153

FIG. 17

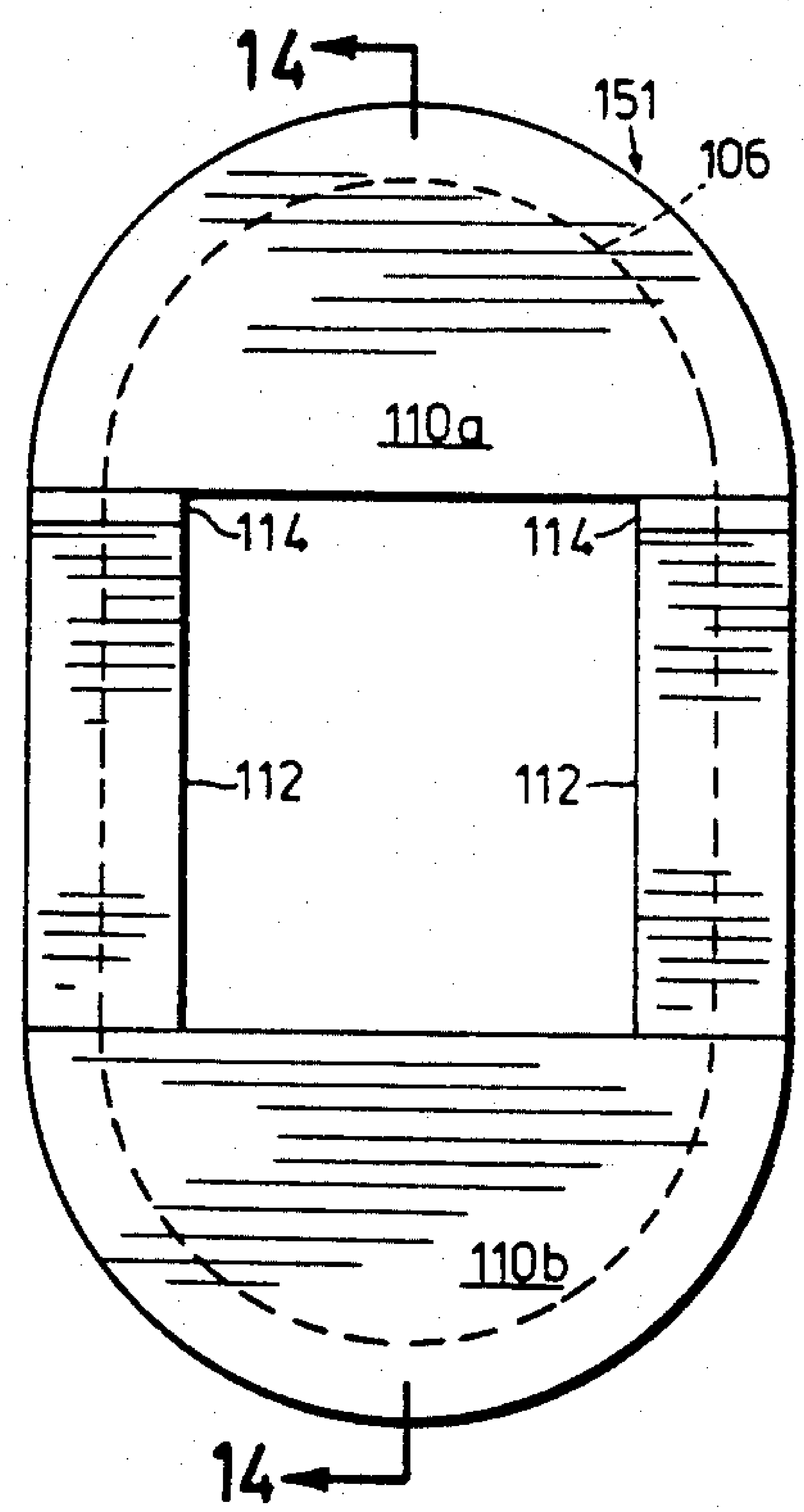


FIG. 13

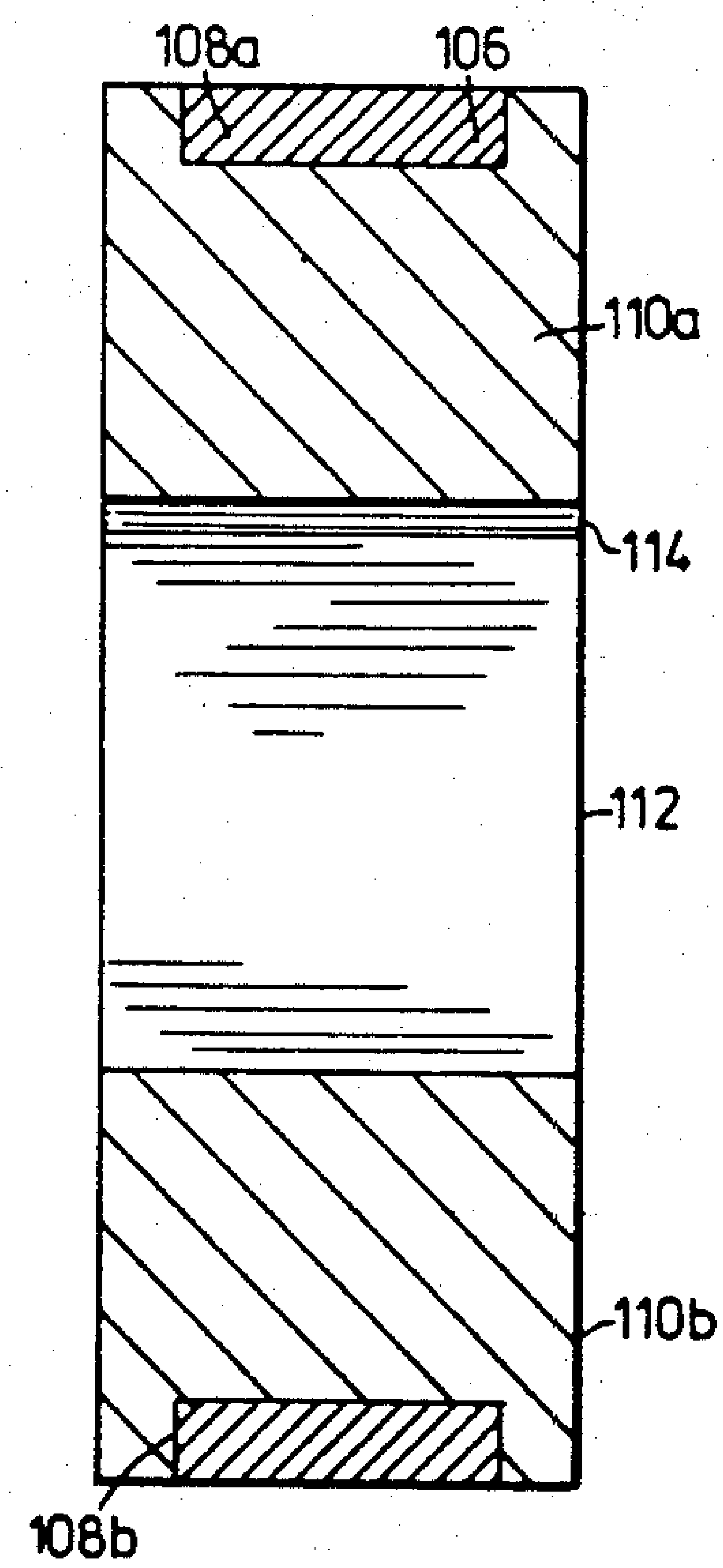


FIG. 14

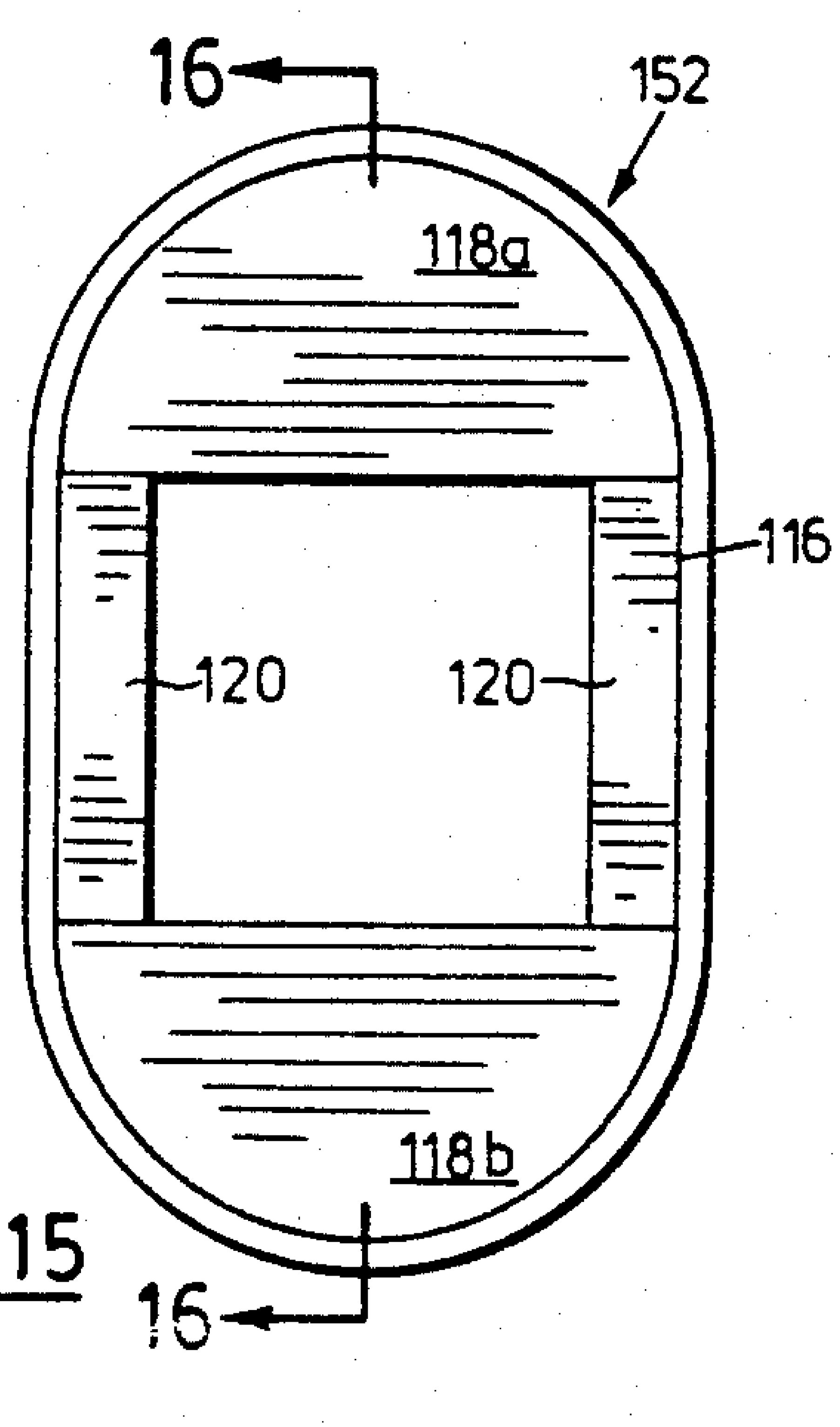


FIG. 15

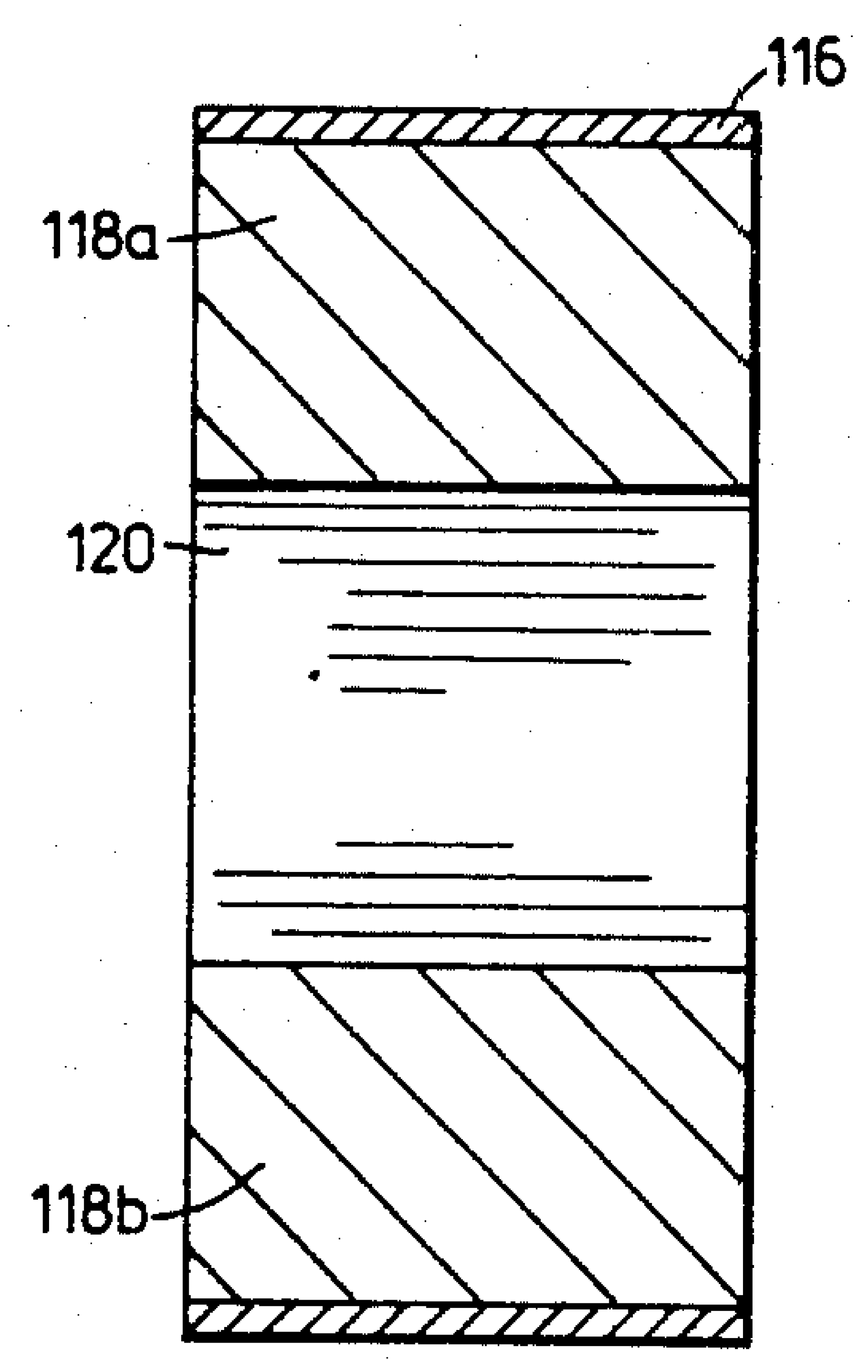


FIG. 16

PRESS WITH WEDGE

This invention relates to a press which employs wedges to provide the clamping forces.

Presses are used for numerous operations, such as molding, die casting, hydroforming, vacuum and pressure forming, forging, hobbing, stamping, fine blanking, powder compaction, and others. Many of these processes require very short but high power strokes. In conventional presses the main clamping device is used not only for opening and closing the mold or other structure to be pressed, but also for the final clamping stroke. This arrangement is uneconomical both initially and in operation. During each clamping operation the frame must be stretched to the full clamping force, which requires a large amount of energy which is lost after each clamping cycle.

The invention in one of its aspects provides a press in which the functions of opening and closing, and performing the clamping stroke, are separated. The opening and closing operation is performed outside the press, typically by inserting the item or other thing to be clamped within a structure to be compressed. The closed structure is then moved into the press, the frame of which is prestressed, and the clamping forces are applied. Since the frame is prestressed, preferably to more than the maximum clamping power used, no energy is required to stretch the frame during each operation and only very little energy is needed to eliminate the sliding gaps between the press structure and the structure to be compressed. Wedges are then used to provide the necessary clamping force.

In one aspect the invention provides a press comprising:

(a) a frame forming a closed loop;

(b) a first pressure surface disposed within said loop;

(c) a movable platen within said loop, which has a second pressure surface opposed to and spaced from said first pressure surface to permit the introduction between said first and second pressure surfaces of a structure to be compressed;

(d) means supporting said movable platen for movement thereof towards and away from said first pressure surface;

(e) wedge means for moving said movable platen towards said first pressure surface to compress a structure disposed between said first and second pressure surfaces, said wedge means including first and second wedges which taper in opposite directions, and which are movable in said directions and means slidably co-operating with said wedge means and adapted to cause movement of the movable platen towards the first pressure surface in response to movement of the wedges in said directions, without imparting any substantial lateral force to the movable platen; and

(f) drive means for propelling said first and second wedges in opposite directions, to move said movable platen relative to said first pressure surface.

In another aspect the invention provides in a press the improvement comprising first and second wedge means for producing pressing forces in said press, means mounting said first and second wedge means for movement in opposite directions for producing said pressing forces, and actuating means for moving said first and second wedge means simultaneously in opposite directions.

Further objects and advantages of the invention will appear from the following description, taken together with the accompanying drawings which show various embodiments of the invention, and in which:

FIG. **1** is a longitudinal sectional view of a press according to the invention;

FIG. **2** is a view taken along lines **2—2** of FIG. **1**;

FIG. **3** is a view taken along lines **3—3** of FIG. **1**;

FIG. **4** is a side view showing the wedges and movable platen of the FIGS. **1** to **3** press with rollers therebetween;

FIG. **5** is a perspective view of the set of wedges of the FIG. **1** press;

FIG. **5***a* is a side view showing a modification of FIG. **5**;

FIG. **6** is a side view of the wedges of FIG. **5** and showing a driving arrangement therefor;

FIG. **7** is a top view of the wedges and driving arrangement of FIG. **6**;

FIG. **8** is a side view of a modified driving arrangement for the wedges of FIG. **5**;

FIG. **9** is a top view of the driving arrangement of FIG. **8**;

FIG. **10** is a perspective view of an alternative form of prestressed frame module for the press of FIG. **1**;

FIGS. **11***a* and **11***b* are side views showing teeth for the frame of FIG. **10**;

FIG. **12** is a graph showing load distributions for the FIGS. **11***a* and **11***b* teeth;

FIG. **13** is a front view showing a module frame for the press of FIG. **1**;

FIG. **14** is a sectional view along line **14—14** of FIG. **13**;

FIG. **15** is a front view of an alternative frame module;

FIG. **16** is a sectional view along line **16—16** of FIG. **15**;

FIG. **17** is a perspective view of another variant of the frame module;

FIG. **18** is a top view partly in section, of a further modified press according to the present invention; and

FIG. **19** is a sectional view, taken along line **19—19** of FIG. **18**.

Reference is first made to FIGS. **1** to **3**, which show a press **10** according to the invention and intended for molding or die forming operations. The press **10** includes a frame **12** which, in principle, comprises top and bottom yokes **14***a*, **14***b* held together by side members **16** as best shown in FIG. **2**. The frame **12** is pre-stressed, as will be described shortly, to more than the maximum clamping power of the press so that no energy is required to stretch the frame during each clamping operation.

In this particular embodiment, the frame is of a modular construction as indicated diagrammatically in FIGS. **1** and **3**. The frame is shown as comprising six modules, which are indicated by the reference numeral **150**. The modules may be of the form shown in FIGS. **13** and **14**; **15** and **16**; or **17** (to be described). As best shown in FIG. **2**, each module comprises respective portions **14***am*, **14***bm* of the yokes **14***a*, **14***b* and portions **16***m* of the side members **16**. These portions **14***am*, **14***bm* and **16***m* are secured together to form a closed loop, so that the respective modules **150** can be handled as separate units. To assemble the frame **12**, the modules **150** are assembled side by side. For convenience, they are assembled together in a support frame (not shown) which ensures correct alignment of the modules **150**. Then, the other components of the press (described below) are assembled in the frame 12 formed of these modules 150. The modules are accurately formed so that, in use, the load applied to the frame 12 is evenly distributed between the modules 150.

This modular design enables the size of the frame 12 to be readily changed to accommodate different sizes of articles that are to be pressed. It is simply necessary to assemble together the required number of modules 150.

The lower surface 18 of the upper yoke 14*a* constitutes a first pressure surface (a separate platen fixed to the upper yoke 14*a* can also be used to provide this pressure surface). A movable platen 20 is located well below the upper yoke 14*a* and has an upper surface 22 facing the first pressure surface 18 and constituting a second pressure surface. The movable platen 20 is guided for vertical movement on the side members 16 by slots 24 in its sides.

The movable platen 20 also has two sloping lower surfaces 26 and 27 which are supported on correspondingly inclined upper surfaces 28 and 29 of actuating wedges 30 and 31 which are movable back and forth horizontally. Both wedges 30 and 31 have respective horizontal lower surfaces 32 and 33 which are supported on the horizontal upper surface 35 of a stationary member 36. Stationary member 36 is in turn fixed to the lower yoke 14*b*, and distributes any applied force to the modules 150. Of course, the wedges need not act directly on platen 20; an intermediate member having surfaces 26, 27 may be employed.

The wedge 30 is formed as a U-shaped wedge which slides to the right as shown in the drawings to produce a clamping force. The U-shaped wedge 30 includes a base 60 and a pair of spaced tapered wedge arms 62 one located on each side of the other wedge 31 (see FIG. 5). The wedge arms 62 and the wedge 31 are supported on the horizontal upper surface of member 36, with the wedge 31 located between the wedge arms 62. The inclined upper surfaces 28, 29 like the surfaces 26 and 27 of the platen 20 have the same though opposite slopes so that uniform upward movement of the movable platen 20 will be achieved when wedges 30, 31 are properly aligned and move at the same speed in opposite directions. The upper surface 28 of the wedge 30 is formed from the combined area of the upper surfaces 64 of wedge arms 62 and is preferably equal to the area of the upper surface 29 of wedge 31 so that the forces needed to move each wedge 30, 31 will be as nearly the same as possible.

The actuating wedges 30 and 31 are propelled horizontally back and forth by a conventional hydraulic cylinder 40. The piston rod 41 of cylinder 40 is connected at 42 to the wedge 31. The cylinder 40 is itself mounted on a support 44 having arms 45. The arms 45 are fixed to the wedge arms 62.

Appropriate lubrication may be provided between the surface 35 of the stationary member 36 and the surfaces 32 and 33, and also between the surfaces 26–29. Since the lower surfaces 32, 33 of the wedges 30, 31 are horizontal, no lateral force can be applied to the assembly comprising the wedges 30, 31 and the platen 20. In use, to load the press, the cylinder rod 41 is drawn into the cylinder 40, thereby moving the wedge 30 to the left and the wedge 31 to the right, as viewed in FIG. 1. The slots 24 in the platen 20 ensure that it stays aligned in the press. The press can then be loaded with a mold, as described below.

FIG. 1 also shows a pair of mold or die halves 48*a*, 48*b* assembled together and ready to be inserted into the space 50 between the first and second pressure surfaces 18, 22. Mold or die halves 48*a*, 48*b* are constructed so that they can be separated to receive or discharge any desired item or thing to be clamped or molded, and then assembled together into a single mold structure as shown. The details of the mold or die, which can e.g. be an injection mold or which can receive and transmit pressure to an item, are not shown since they are conventional.

The lower mold or die half 48*b* is supported, by means of slots 52 in its sides, which have a sliding fit on a pair of rails 54 which extend through the space 50. The rails 54 are secured to the side members 16. The arrangement is dimensional so that when the mold or die halves are slid into the space 50, there are only small clearances between the top of the upper mold or die half 48*a* and the first pressure surface 18, and between the bottom of the lower mold or die half 48*b* and the second pressure surface 22 [assuming that wedges 30, 31 have been withdrawn (as described above)].

In operation, the material or other item to be molded or pressed is placed within the mold or die halves 48*a*, 48*b* which are then assembled together and closed outside the press. The mold or die halves 48*a*, 48*b* are then slid along the rails 54 into the space 50 in the press. (If the mold is an injection mold, it is filled with hot plastic or other material after it has been inserted into the space 50 and clamped.) At this time the upper surfaces 56 of the slots 52 in the lower mold or die half 48*b* rests on the tops of the rails 54. The movable platen 20 and the wedges 30, 31 are as indicated dimensioned to allow a small clearance between the bottom of the lower mold or die half 48*b* and the second pressure surface 22 at this time.

When the mold or die halves are in position, cylinder 40 is actuated to drive the actuating wedge 30, 31 towards one another, i.e. the wedge 30 moves to the right and the wedge 31 moves to the left as shown in FIG. 1, closing the clearances and lifting the movable platen 20 and the mold or die halves so that the rails 54 are approximately centered in the slots 52. (As shown, the rails 54 are of lesser height than the slots 52 in this position.) This ensures that the rails will not be stressed during the clamping operation. As the wedges 30, 31 continue to be driven in their respective and opposite directions, clamping force is exerted on the mold or die halves 48*a*, 48*b* to perform the required molding or other operation. Since the frame 12 is prestressed and no energy is required to stretch it, only a small quantity of energy is required to eliminate the sliding gaps between the mold or die halves 48*a*, 48*b* and the pressure surfaces 18, 22 and to supply the necessary clamping forces.

Although only one mold or die has been shown, preferably two molds or dies will be used so that while one is being loaded or unloaded, the other can be processed in the press.

Preferably, the lower surfaces 26,27 of the platen 20 are symmetrical, to aid substantially parallel movement of the movable platen 20 under maximum power and under unbalanced loading conditions. The use of two opposed wedges 30, 31 ensures that no lateral force is applied to the platen 20. These features are extremely difficult to obtain in conventional presses without very high cost.

It will be appreciated that the movement of the actuating wedges **30, 31** can be programmed as required for structural foam molding, hobbing, or other processes. The sliding wedge surfaces can be treated with anti-friction materials as required, or they may be equipped with rollers to reduce friction. Such rollers are diagrammatically indicated in FIG. **4**, which shows elongated rollers (i.e. roller bearings) **55,56, 57** held in elongate cages **55***a*, **56***a*, **57***a* respectively. Two sets of rollers **55** and two corresponding cages **55***a* are provided. These are located between the upper surfaces **64** of the wedge arms **62** and the surface **26** of the platen **22**. The rollers **56** and associated cage **56***a* are located between the upper surface **29** of the wedge **31** and the surface **27** of the platen **20**. Thus, the rollers **55,56** permit relative movements between the wedges **30, 31** and the platen **20**. The rollers **57** are located between the wedges **30, 31** and the stationary member **36**, to permit horizontal movement of the wedges **30, 31** relative to the stationary member **36**. The rollers **57** are provided in three parallel sets or rows, each of which has its own associated cage **57***a*. Two outer rows of rollers **57** are located between the wedge arms **62** and the stationary member **36**. A third row of rollers **57** is located between these two rows, and between the wedge **31** and the stationary member **36**. This permits the wedges **30, 31** to travel in opposite horizontal directions.

It is also possible for each of the wedge arms **62** and wedge **31** to comprise two or more wedges, arranged in a series. By way of example, FIG. **5***a* shows an arrangement in which each of the wedge arms **62** and the wedge **31** comprises three wedges denoted **62***a* and **31***a* respectively. The front wedge arm **62** has been omitted from FIG. **5***a* for clarity.

Various types of drives may be used to propel wedges **30, 31**. As discussed above, a hydraulic cylinder **40**, having a piston rod **41**, can be used. The cylinder **40** is fixed to be base of a support **45** whose side arms **44** are secured to wedge arms **62**. The cylinder rod **41** protrudes through the base and is connected to the wedge **31**. When the piston rod **41** retracts, wedge **31** moves to the right and wedge arms **62** of wedge **30** move to the left, and when the piston rod **41** extended the wedges **30, 31** again move in opposite directions. As shown in FIGS. **6** and **7**, if high accuracy is desired, then rack teeth **69***a*, **69***b*, **70***a*, **70***b* are provided at the opposed sides of the respective wedges **30, 31** and engage idler pinions **71***a*, **71***b* rotatably mounted on shafts **72***a*, **72***b* fixed to the frame **12**. The upper ends of the pinions **71***a*,**71***b* or pinion shafts are accommodated in slots **72***c* in the movable platen **20**. The pinions **71***a*, **71***b* prevent unequal movement of the wedges **30, 31** and ensure that wedge arms **62** move to the same extend in one direction as wedge **31** moves in the other direction. A variant of the wedge **30** discussed previously is shown in FIGS. **6** and **7**. In this variant, the wedge arms **62** are separate and are not joined by a base **60** as previously shown.

Alternatively, as shown in FIGS. **8** and **9**, the wedges **30, 31** may be powered directly by a pair of pinions, **73***a*, **73***b* engaging teeth **74***a*, **74***b*, **75***a*, **75***b* on the side faces of the wedges **30, 31**. The pinions **73***a*, **73***b* are fixed to gears **76***a*, **76***b* rotatably mounted in the base member **36**. The gears **76***a*, **76***b* are driven by a common driving pinion **80** powered by an electric, hydraulic or air motor (not shown). This ensures that equal displacement of the wedge arms **62** of the wedge **30** and of the wedge **31** occurs. Again, in FIGS. **8** and **9**, the wedge arms **62** are shown separate from one another.

In each of the embodiments of FIGS. **6, 7** and FIGS. **8, 9**, the movable platen is located for vertical movement by pins **81** which extend downwardly between the wedges and are received in guides (not shown) in the fixed platen or in the frame.

FIG. **10** shows an alternative form of prestessed frame which can be used for a one-piece or modular frame construction. As shown, the yokes **14***a*, **14***b* have teeth **86***a*, **86***b* respectively at their ends, which engage corresponding teeth **88***a*, **88***b* in tie bars **90**. The tie bars **90** are prestressed (stretched) so that they are under a tension force which exceeds the maximum clamping force expected in the press. The tie bars **90** are maintained in their stretched condition by compression bars **92** which extend between the respective yokes **14***a*, **14***b* and hold the yokes apart. The space **94** between the yokes **14***a*, **14***b* and compression bars **92** accommodates the platen or platens, wedges and guide rails as described above. As shown, ends of the tie bars are tapered. The top of the yoke **14***a* comprises a flat portion and two sloping edge portions. The bottom yoke **14***b* is adapted to receive the tie bars **90** and includes feet **95** provided with holes for securing the frame **12** in position.

To assemble a frame of the kind shown in FIG. **10**, the yokes **14***a*, **14***b* and the compression bars **92** are assembled together, and then the tie bars **90** are heated to a temperature sufficient to extend them to the required degree. The heated tie bars **90** are then fitted to the yokes and cooled, placing them under the required tension. Either the compression bars or the tie bars can then be used for mounting the mold sliding rails **54**. Because the tie bars are prestressed, the energy that would otherwise be required to stress them during each clamping operation is saved. The conventional keys and screws used to locate and hold the parts together are not shown, for simplicity.

In a frame such as that shown in FIG. **10**, it is desirable that the load on each mating pair of the teeth **86***a*, **86***b*, **88***a*, **88***b* be kept as uniform as possible. If the teeth were of constant pitch, as shown in FIG. **11***a* (which shows the teeth mating prior to prestressing), then the load would be highest on the first tooth and would be much less on each succeeding tooth, as shown in curve **95** in FIG. **12**. Failure would then tend to begin at tooth **96** in FIG. **11***a*, as indicated by crack **97**, and could eventually result in complete failure of the tie bar **90**.

To avoid this difficulty, a tooth design as shown in FIG. **11***b* is preferred, in which the pitch or distance between teeth decreases for each tooth on the tie bar prior to prestressing, the yoke having constant pitch teeth. As shown in FIG. **11***b*, in the non-prestressed condition the gap at **98** is zero; the gap at **100** is the amount of expansion of one tooth under full tensioning or prestressing; the gap at **102** is the amount of expansion of two teeth under full tensioning, etc. The amount of expansion of each tooth is constant. Then, when the tie bars **90** are prestressed, each of the gaps **100, 102** etc. becomes substantially zero, provided that such gaps have been properly dimensioned for the particular prestress load to be applied. The stress distribution for the teeth is then shown at **104** in FIG. **12** and will be seen to be substantially uniform. This tooth design can also be used for frames which are not prestressed, in which case, when the frame is stressed (i.e. when clamping is occurring) the teeth will be approximately evenly loaded, and at other times there will be gaps between all the mating teeth except the first pair.

The tie bars can have constant pitch and the yokes or plates variable pitch if necessary.

FIGS. **13** and **14** show a frame module **151** which may be used in a frame of the form shown in FIGS. **1** to **3**. The module comprises an integral annular ring **106** which at its top and bottom runs through slots **108***a*, **108***b* in upper and lower yokes **110***a*, **110***b*. The yokes **110***a*, **110***b* are held apart by compression bars **112**. To prestress the frame, the yokes **110***a*, **110***b* are forced apart by any desired expansion means, such as hydraulic jacks, and stressing spacers **114** are inserted above the compression bars **112** to eliminate the spaces created by the stretching of the ring **106**. The compression bars **112** and stressing spacers **114** are provided with slots corresponding to the slots **108***a*, **108***b*. The expansion means is then removed.

An alternative form of module is shown in FIGS. **15** and **16** and is designated **152**. In this case there are no slots in the yokes or in the compression bars. A ring **116** is employed which is wider and thinner than the ring **106** of FIGS. **13** and **14**. The ring **116** extends across the full width of this module **152**. For this reason, the yokes **118***a* and **118***b* and compression bars **120** are provided with plain outer surfaces. To assemble this module, the yokes **118***a*, **118***b* and compression bars **120** are laid on a horizontal surface. Then, the annular ring **116** is heated to expand it. It is then dropped over the yokes and compression bars and allowed to cool. Once it is cool, the ring **116** is prestressed to the correct tension.

An alternative form of module is shown in FIG. **17** and is designated by the reference **153**. It comprises a top yoke **122***a*, a bottom yoke **122***b* and compression bars **123**. Around the top yoke **122***a* and the compression bars **123** U-shaped tension bars or strips **124** are positioned. As shown, two tension strips **124** are provided although just one stronger strip **124**, or three or more tension strips **124**, could be provided. Each end of each tension strip **124** is provided with a tooth **125**, which extends across the width of the strip. These teeth **125** engage corresponding teeth **126** of the bottom yoke **122***b*. Again, each strip **124** could be provided with two or more teeth. This construction is assembled similarly to the frame shown in FIG. **10**. The yokes **122***a*, *b* and the compression bars **123** are assembled together, either vertically or horizontally. Then, the strips **124** are heated and placed in position. On cooling, the strips **124** contract to set up the required tension in each strip **124**.

Finally, reference is made to FIGS. **18** and **19** which show an embodiment of the invention which uses an annular prestressed frame or ring **125** held in a stressed condition by four identical truncated sector shaped compression members **126**. To assemble the structure of FIGS. **18** and **19**, the compression members **126** are assembled together and, as before, the ring **125** is then heated to expand it. The ring **125** is then placed over compression members **126**, cooled, and screwed in place (with fasteners not shown).

The flat truncated surface **128** of each compression member support wedges **130**, **131** which in turn support a movable platen **132**. The wedges **130**, **131** generally correspond to the wedges **30**, **31** described above. The drive means for these wedges **130**, **131** and their exact mode of operation is not described here as it is similar to that described above. The platens **132**, each of which is similar to the movable platen **20**, are guided for radial movement inwardly and outwardly by slots **134** in circular frame side plates **136**. One side plate **136** is mounted on each side of the ring **125** and compression members **126**. Each wedge **131** is located between two oppositely directed wedges **130**. The wedges **130** extend through openings **138** in the top side plates **136** (FIG. **19**), whilst the wedges **131** extend through openings **138** in the bottom side plates **136**.

In operation, a mold or die **140** to be compressed is suspended (eg. by a hook **142** on its top) and is lowered through a hole **144** in the upper side plate **136** to a position between the movable platens **132**. The wedges **130**, **131** are then driven in opposite directions inwardly with respect to the whole press (by any desired means as previously discussed). This forces all four movable platens **132** radially inwards against the faces of the mold or die **140** to provide uniform compression.

The press described can also be used for molds, dies or other structures to be compressed, fixed to stationary or movable platforms. In all of the embodiments shown, the movable platens may be provided with springs (not shown) to bias them to a withdrawn position when the wedges are retracted.

Any number of compression members can be used.

I claim:

1. A press comprising:

(a) a frame forming a closed loop;

(b) a first pressure surface disposed within said loop;

(c) a movable platen within said loop, which has a second pressure surface opposed to and spaced from said first pressure surface to permit the introduction between said first and second pressure surfaces of a structure to be compressed;

(d) means supporting said movable platen for movement thereof in a direction towards and away from said first pressure surface;

(e) wedge means acting between said frame and platen for moving the movable platen towards said first pressure surface to compress a structure disposed between said first and second pressure surfaces, said wedge means including first and second wedges which are movable in opposite directions in a plane generally at right angles to said direction of platen movement, said wedges having respective inclined surfaces which taper in opposite directions with respect to said plane and respective support surfaces which are disposed in said plane; said platen having correspondingly inclined surfaces co-operating with said inclined surfaces of the wedge means and adapted to cause movement of the movable platen towards the first pressure surface in response to inward movement of the wedges in said opposite directions; and

(f) drive means for propelling said first and second wedges in opposite directions to move said movable pressure surface; said inclined surfaces and drive means being arranged to cause said movement of the movable platen towards said first pressure surface without imparting any substantial lateral force to the movable platen.

2. A press according to claim **1** wherein said frame includes a pair of side members, said movable platen being guided on said side members during movement thereof.

3. A press according to claim **1** wherein said first wedge comprises a pair of wedge members located on either side of said second wedge.

4. A press according to claim **1** wherein the wedge means acts directly between the frame and the movable platen.

5. A press according to claim 4, wherein said means defining correspondingly inclined surfaces co-operating with the inclined surfaces of the wedge means comprise portions of said platen, said first and second wedges being arranged with their inclined surfaces slidingly co-operating with the inclined surfaces of the platen.

6. A press according to claim 1 and including a pair of rails extending into the space between the first and second pressure surfaces, for guiding said structure into said space, said structure including slots at the sides thereof, said slots being of height greater than that of said rails so that when said structure is compressed between said first and second pressure surfaces, said rails do not contact the tops or bottoms of said slots.

7. A press according to claim 1 wherein said structure is a mold or die comprising a pair of separable halves.

8. A press according to claim 1 wherein said frame comprises an upper yoke, a lower yoke, a pair of compression bars mounted between said yokes at the sides thereof, and a pair of tensioned tie bars connecting said yokes, the tension in said tie bars acting to compress said compression members.

9. A press according to claim 8 wherein said tie bars and said yokes have mating teeth connecting said tie bars and said yokes together, the pitch of the teeth on said tie bars being non-uniform under zero tensioning of said tie bars and being proportioned so that under said tensioning of said tie bars, said teeth of said tie bars engage the teeth of said yokes with substantially no gaps at any tooth so that each tooth is under substantially the same stress as each other tooth.

10. A press according to claim 1, wherein said frame comprises a pair of yokes, a pair of compression members between said yokes and a ring encircling the yokes and compression members, with the compression members maintaining said ring in tension.

11. A press according to claim 10, wherein the yokes and the compression members include external slots, in which the ring is seated.

12. A press according to claim 10, wherein the yokes and compression members have plain exterior surfaces and the ring is of the same width as the yokes and the compression members.

13. A press as claimed in claim 1 wherein the frame is pre-stressed and comprises a plurality of individual modules, each of which modules comprises a pair of yokes, and a pair of compression members between said yokes, and a ring encircling the yokes and compression members, with the compression members maintaining said ring in tension.

14. A press according to claim 1 wherein said means (f) comprises hydraulic actuating means including a cylinder a piston in said cylinder, said piston having a rod, and means connecting said cylinder to said first wedge means and said rod to said second wedge means so that when said piston is moved in said cylinder, said first wedge means will move in one direction and said second wedge means will move in the opposite direction.

15. A press according to claim 14 wherein said first and second wedge means each includes rack teeth, and said press includes a pinion means engaging said rack teeth to equalize the movement in opposite directions of said first and second wedge.

16. A press according to claim 1 wherein said first and second wedges include rack teeth, and the press includes pinion means engaging said rack teeth to equalize the movement in opposite directions of said wedges, and means for driving said pinion means to propel said wedges.

17. A press according to claim 1, wherein the frame comprises a prestressed annular ring, and a plurality of compression members within the ring and maintaining the ring in tension.

18. A press as claimed in claim 17, wherein the compression members define two first pressure surfaces and two second pressure surfaces generally opposite the first pressure surfaces, which pressure surfaces define a generally square aperture, and a wedge means is provided adjacent each pressure surface, each wedge means comprising first and second wedges which taper in opposite directions, and a movable platen which can be moved towards a centre of the press by movement of the respective first and second wedges in opposite directions; whereby, in use, a structure to be compressed is located in said square aperture and said first and second wedges are all moved in their respective opposite directions, to compress said structure in two mutually perpendicular directions.

19. A press as claimed in claim 1, wherein at least one of said first and second wedges compirses at least two wedges arranged in a series.

20. A press comprising:

(a) a frame forming a closed loop;

(b) a first pressure surface disposed within said loop;

(c) a movable platen within said loop, which has a second pressure surface opposed to and spaced from said first pressure surface to permit the introduction between said first and second pressure surfaces of a structure to be compressed;

(d) means supporting said movable platen for movement thereof towards and away from said first pressure surface;

(e) wedge means for moving said movable platen towards said first pressure surface to compress a structure disposed between said first and second pressure surfaces, said wedge means including first and second wedges which taper in opposite directions and which are movable in said directions, and means slidably co-operating with said wedge means and adapted to cause movement of the movable platen towards the first pressure surface in response to movement of the wedges in said directions, without imparting any substantial lateral force to the movable platen; and,

(f) hydraulic actuating means including a cylinder, a piston in said cylinder, said piston having a rod, and means connecting said cylinder to said first wedge means and said rod to said second wedge means so that when said piston is moved in said cylinder, said first wedge means will move in one direction and said second wedge means will move in the opposite direction.

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